(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 894 739 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.02.1999 Bulletin 1999/05

(51) Int. Cl.[6]: **B65F 3/04**

(21) Application number: **97650030.6**

(22) Date of filing: **31.07.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

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(54) Device for handling garbage containers

(57) The invention relates to a device (4) for taking up a garbage container and emptying it into a collection container positioned on the chassis (1) of a garbage collection truck, said device (4) comprising a gripping member (30) being operable to grip the garbage container, raise it and tilt it over, so that the garbage present therein falls out into the collection container (4), characterized in that the device comprises a lift arm (25) and a swing/tilt arm (26) at the end of which is rotatably mounted the container engaging unit, the lift arm (25) being linked in a first parallel linkage arrangement (32) with a first pivot arm (33) and the swing/tilt arm being linked in a second parallel linkage arrangement with a second pivot arm (43); a rotary actuator being provided between the first parallel linkage arrangement and the second parallel linkage arrangement so that the swing/tilt arm (26) can turn through an angle of approximately 90° about its axis of rotation in the horizontal plane, and also tilt upwardly and downwardly relative to the same axis, whereby a garbage container placed within the reach of the device and at the side of the truck can be gripped, picked up and be rotated rearwardly in order to be brought over the collection container and to be emptied thereinto and whereby the device is selectively operable to lift and empty individual garbage containers from a group of garbage containers without having to move the truck.

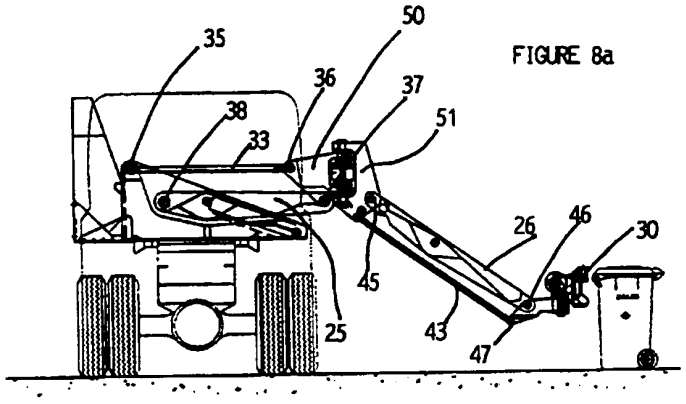


FIGURE 8a

EP 0 894 739 A1

Description

[0001] The present invention concerns devices for handling garbage containers.

[0002] Prior art trucks are known which include an arm extending from the body of the truck for taking up and emptying a garbage container into the collecting container. An example of such a device is disclosed in the specification of European Patent Specification No. EP 0 638 491-B. However, prior art devices are not capable of being manoeuvred and controlled to the extent that the device can pick up garbage containers from a group of garbage containers and return each garbage container to its previous location. Furthermore, The movements of some of the arms tend to be jerky and are controlled by manual control by an operator manipulating joysticks.

[0003] The apparatus of the present invention seeks to alleviate the disadvantages of the prior art.

[0004] The present invention provides a device for taking up a garbage container and emptying it into a collection container positioned on the chassis of a garbage collection truck, said device comprising a gripping member being operable to grip the garbage container, raise it and tilt it over, so that the garbage present therein falls out into the collecting container, characterized in that the device comprises a lift arm and a swing/tilt arm at the end of which is rotatably mounted the container engaging unit, the lift arm being linked in a first parallel linkage arrangement with a first pivot arm and the swing/tilt arm being linked in a second parallel linkage arrangement with a second pivot arm; a rotary actuator being provided between the first parallel linkage arrangement and the second parallel linkage arrangement so that the swing/tilt arm can turn through an angle of approximately 90° about its axis of rotation in the horizontal plane and also tilt upwardly and downwardly relative to the same axis, whereby a garbage container placed within the reach of the device and at the side of the truck can be gripped, picked up and be rotated rearwardly in order to be brought over the collection container and to be emptied thereinto and whereby the device is selectively operable to lift and empty individual garbage containers from a group of garbage containers without having to move the truck.

[0005] Advantageously, the device for taking up a garbage container and emptying it into the collecting container includes the following actuators:

a lift hydraulic ram (5) for lifting the lift arm (25) up and lowering it down again;

a swing (rotary) actuator (6) connected to the swing/tilt arm (26) enabling the swing/tilt arm (26) to turn about the vertical axis perpendicular to the body of the truck;

a tilt hydraulic ram (7) mounted on the swing/tilt arm (26) for controlling the tilting of the swing/tilt arm (26);

a turn hydraulic ram (8) mounted on a turn head (28); for controlling the turn motion of the grab unit 30;

a tip (rotary) actuator (9) mounted on the tipping head (29) for enabling the grab unit (30) to grip the garbage container and, after the container has been raised by the device, for enabling the grab unit to tilt the garbage container so that the garbage present therein falls out into the collection container;

a clamping hydraulic ram (10) for controlling the clamping and unclamping of the garbage container by the grab unit 30.

[0006] Preferably, the grab unit (30) is also operable to grip a garbage container which is standing on a surface which is not completely horizontal.

[0007] Conveniently, the device for taking up a garbage container is controllable in both manual and automatic modes; control in manual mode being exercised by means of an operator manipulating joysticks in the cab of the truck and control in automatic mode being carried out by a programmable logic controller (PLC), whereby during an operational cycle through which the device (4) moves to grab the garbage container, lift it from the ground and position it over the collecting container, tilt the garbage container to an appropriate angle to empty the contents of the garbage container into the collecting container, lower the garbage container and position it back on the ground, the device (4) is controlled in manual mode for certain stages of the operational cycle and in automatic mode for other stages of the operational cycle.

[0008] Preferably, the operational cycle includes a start-up sequence during which the device (4) is moved from a folded transportation position at the rear of the truck to a position in which it is extended in the direction of the garbage container and also includes a "homing" sequence during which the device returns from the extended position to the folded transportation position.

[0009] Advantageously, automatic mode information regarding the position of each of the arms is relayed back to the PLC by optical encoders.

[0010] The invention will now be described more particularly with reference to the accompanying drawings in which are shown one embodiment of the truck according to the invention.

[0011] In the drawings:

Figures 1-9 show the positions of the device of the invention during the operation cycle; (In Figure 1-9 hidden detail is shown for description purposes)

Figure 1a is a rear view of the truck showing the device in the "home" position for transport;

Figure 1b is a plan view of the truck with the device in the "home position" as shown in Figure 1a;

Figure 2a is a rear view of the truck showing the truck stopped in the general vicinity of a garbage container and with the device extending towards the garbage container;

Figure 2b is a plan view of the truck and device in the position shown in Figure 2a;

Figure 3a is a rear view of the truck with the arm being positioned under the lip of the garbage container in preparation for lifting; and also illustrates the collection area boundary in the vertical plane;

Figure 3b is a plan view of the truck and device in the position shown in Figure 3a;

Figure 4a is a rear view of the truck with the device lifting the garbage container clear of the ground;

Figure 4b is a plan view of the truck and device in the position shown in Figure 4a;

Figure 5a is a rear view of the truck showing the device lifting the garbage container to the tipping position;

Figure 5b is a plan view of the truck and device in the position shown in Figure 5a;

Figure 6a is a rear view of the truck showing the device returning the emptied garbage container to the position shown in Figure 4a;

Figure 6b is a plan view of the truck and device in the position shown in Figure 6a;

Figure 7a is a rear view of the truck with the device placing the emptied garbage container back on the pavement;

Figure 7b is a plan view of the truck and device in the position shown in Figure 7a;

Figure 8a is a rear view of the truck and device moving clear of the emptied garbage container;

Figure 8b is a plan view of the truck and device in the position shown in Figure 8a;

Figures 9a and 9b are rear view and plan view, respectively, of the truck and device returned to the "home position" as shown in Figure 1a and 1b;

Figure 10a and 10b are detailed rear view and plan view respectively, of the truck and device;

Figure 11a is a side sectional view of the tilt and turn mechanism provided on the device;

Figure 11b is a plan view of the tilt and turn mechanism;

Figure 12a is a detailed side sectional view of the device showing encoders included on the tipping head;

Figure 12b is a detailed plan view of the tipping head;

Figure 13a is a further detailed sectional view showing the tilt and turn mechanism and encoder mounting positions;

Figure 13b is a detailed plan view of the tilt and turn mechanism and encoder mounting positions;

Figure 14 is a schematic flow chart showing the electrical circuit linking the joysticks operated by the operator and the encoders on the lift arm and swing/tilt arm;

Figure 15 is a circuit diagram of the hydraulic circuit;

and Figure 16 is a side view of the garbage collection truck with the device of the invention mounted thereon and an interchangeable collection container also shown mounted on the truck.

[0012] Referring to the drawings, the truck is indicated generally by reference numeral 1. The truck includes an interchangeable collecting container 90, a base bracket 3 which supports an extension arm mechanism (device) generally indicated by reference numeral 4. The arm extension mechanism includes two parallel linkages indicated generally by reference numerals 32,42. The first of these parallel linkages 32 is provided by the lift arm 25 and a pivot arm 33 and is defined by pivot points 35,36,37,38. The lift arm 25 and pivot arm 33 are connected at pivot points 38,35 respectively to a bracket 50. A rotary actuator 6 is mounted on the bracket 50. The second of the parallel linkages 42 is provided by the swing/tilt arm 26 and a pivot arm 43 and the parallel linkage 42 is defined by pivot points 45, 46,47,48. The pivot points 45,48, about which the swing/tilt arm 26 and the pivot arm 43 move, are provided on a bracket 51 which is also connected to the rotary actuator 6. The arm extension mechanism also includes a container engaging member provided at the end of the arm. The container engaging member includes a tipping head 29 and a grab unit 30.

[0013] Four optical encoders are provided at the fol-

lowing locations on the extension arm:

an encoder 12 is mounted remotely, by a belt drive, from the pivot point 36 of the pivot arm 33, which is connected by parallel linkage 32 to the lift arm 25. Therefore, the encoder 12 reads the angle of elevation of the lift arm 25;

an encoder 14 reads the angle of rotation about the axis of rotation of the bracket 51. The encoder 14 is mounted remotely by belt drive, from the shaft 49 of the swing/tilt arm 26;

an encoder 16 is mounted remotely by belt drive, from pivot point 45 about which the swing/tilt arm 26 moves and encoder 16 records information about the up and down location of the swing/tilt arm 25,

an encoder 18 is provided on the shaft of the tipping head 29.

[0014] The arm extension mechanism 4 comprises six hydraulic actuators, namely four ram type actuators and two rotary actuators. These six hydraulic actuators comprise the following:

a lift hydraulic ram 5 for lifting the lift arm 25 up and lowering it down again. The hydraulic lift ram 5 is mounted on the base bracket 3 and connected at its other end to the lift arm 25;

a swing actuator 6 connected to the bracket 51 which is in turn connected to the swing/tilt arm 26; the swing actuator 6 is a rotary actuator located on the extension arm mechanism 4 near to the body of the truck. The swing actuator 6 enables the swing/tilt arm 26 to turn about the vertical axis perpendicular to the body of the truck. The swing/tilt arm 26 can be moved approximately 45° both sides off centre;

a tilt hydraulic ram 7 also mounted on the swing/tilt arm 26; the tilt hydraulic ram 7 is used for controlling the tilting of the arm;

a turn hydraulic ram 8 mounted on a swivel head 28; the turn hydraulic ram 8 is used to control the turning motion of the grab unit 30 and can cause tipping head 29 to be turned through an angle of 90° (i.e. 45° either side off centre). This movement allows the operator to collect garbage containers which are not parallel to the truck;

a tip actuator 9 mounted on the tipping head 29; the tip actuator 9 is a rotary actuator and is provided in the tipping head 29 to enable the grab unit 30 to tip the garbage container (180°) upside down during a tipping operation. It is also used to compensate the collection angle if the garbage container is sloping backwards or forwards on the pavement;

a clamp ram 10 also mounted on the grab unit 30; the clamping hydraulic ram 10 controls the clamping and unclamping of the garbage container by the grab unit 30.

[0015] During its operational cycle as shown in Figures 1a through to 9b, the arm extension mechanism 4 can be controlled either manually (manual mode) by the operator who moves one of three joysticks to control the direction and extent of movement of the arm extension mechanism 4. Certain stages of the operational cycle can only be controlled automatically (automatic mode).

[0016] Five of the above referred to hydraulic actuators 5,6,7, 8 and 9 can be controlled in manual mode as well as automatic mode but the clamp ram 10 can only be controlled in automatic mode during start-up sequence.

[0017] Each of the five actuators is controllable in manual mode, namely the lift hydraulic ram 5, the swing rotary actuator 6, the tilt hydraulic ram 7, turn hydraulic ram 8 and the tip actuator 9 are controlled by their respective joystick, situated in the cab of the truck. When the operator moves a joystick, the corresponding actuator is moved by means of an electrical solenoid valve which opens the hydraulic supply to the actuator, provided that the controls are in manual mode and safety interlocks allow that movement.

[0018] As shown in Figures 1a,1b,2a,2b,3a,3b,4a and 4b, the operator initially manually positions the arm of the truck to grab and lift the garbage container. Once the garbage container has been raised to a position just above the ground, by the arm under manual control, automatic mode can then be selected.

[0019] In automatic mode, all six actuators can be moved as necessary to raise the garbage container, and locate it over the collecting container so that it is tipped, emptied and then returned to a position just above the ground.

[0020] Manual control is automatically reinstated once the garbage container has been returned by the arm, to a position just above the ground, so that the operator can manipulate the joysticks to place the garbage container back on the ground and move the arm clear of the garbage container. The operator can then drive the truck to the next collection point if necessary and repeat the operation. Alternatively, if the garbage containers are collected together in a group, the operator will manipulate the joysticks and the arm will be made to grab another garbage container and repeat the tipping and emptying operation.

[0021] Once all the garbage containers at a particular location have been emptied and returned to the ground the "homing cycle" can be activated by the operator pressing a button on the control panel of the truck. The homing cycle will only be used if travelling long distance.

The "homing cycle" is controlled in automatic mode and brings the arm back from any position in the operational cycle to the home position shown in Figures 9a and 9b ready for transportation.

[0022] The five actuators controllable in manual mode are controlled in the following way.

[0023] The lift ram 5 is moved up or down by moving the first joystick (joystick A) to the left or right. A left of centre movement of joystick A corresponds to an up movement of the lift ram 5 and a right of centre movement of the joystick corresponds to a down movement of the lift ram 5.

[0024] The swing rotary actuator 6 is moved forward or backward in relation to the truck by moving the first joystick (joystick A) again but this time forwards or backwards. A forward of centre movement of joystick A corresponds to a forward movement of the swing actuator 6 and a backwards of centre movement of the joystick corresponds to a backwards movement of the swing actuator.

[0025] The tilt ram 7 is moved up or down by moving the second joystick (joystick B) left or right. A left of centre movement of joystick B corresponds to an up movement of the tilt ram 7 and a right of centre movement of joystick B corresponds to a down movement of the tilt ram 7.

[0026] The turn ram 8 is moved forward or backward in relation to the truck by moving the second joystick (joystick B) again but this time forwards or backwards. A forward of centre movement of the joystick corresponds to a forward movement of the turn ram 8 and a backwards of centre movement of the joystick corresponding to a backwards movement of the turn ram 8.

[0027] The tip rotary actuator 9 is moved up or down by moving the third joystick (joystick C) up or down. An up of centre movement of the joystick corresponds to an up movement of the tip actuator 9 and a down of centre movement of the joystick corresponds to a down movement of the tip actuator 9.

[0028] Referring now particularly to Figures 1 to 9 and Figure 14, the sequence of operation of the arm extension mechanism 4 will be described. The movements of the arm from the "home position" in which the arm is folded at the back of the truck cab as shown in Figures 1a and 1b to the position shown in Figures 4a and 4b in which the arm has engaged the garbage container and lifted it off the ground are carried out under manual control by the operator.

[0029] When the first joystick (joystick A) shown on Figure 14 is moved left of centre by an operator controlling the actuators in manual mode, a voltage of between 5 and 10 volts is sent to the analogue input module of the programmable logic controller (PLC). The further left of centre the movement of joystick A, the greater the voltage sent to the input module, to a maximum of 10 volts. This voltage signal is read by the PLC and if all conditions related to the resulting movement (i.e. lift up) are met, then the analogue output module of the PLC will send a corresponding voltage signal, also in the range 5 to 10 volts, to an amplifier which boots the voltage up to a range from 14 to 20.7 volts, dependent on the voltage inputted into the amplifier. This voltage in the range 14 to 20.7 volts is then sent to the electrical solenoid valve controlling the lift ram 5 thereby causing the valve to open and allowing hydraulic oil to pass and fill the cylinder full bore thereby extending the lift ram 5 and moving the lift arm 25 upwardly.

[0030] As the lift ram 5 moves up, the absolute encoder 12 relays information regarding the actual position of the lift arm 25 to the programmable logic controller (PLC) discrete input module which is in turn read by the computer program controlling the operational cycle. If the position information regarding the position of the lift arm 25 reaches a pre-determined parameter setting, the PLC will limit the voltage from the analogue output module and thereby prevent certain manual movements.

[0031] When the first joystick (joystick A) is moved right of centre in manual mode, a voltage of between 5 and 0 volts is sent to the analogue input module of the PLC. The further right of centre the movement of joystick A, the further the voltage decreases down to a minimum of 0 volts. This voltage signal is read by the PLC and if all conditions relating to the resulting movement, i.e. the lift down movement, are met then the analogue output module of the PLC will send a corresponding voltage signal also in the range 5 to 0 volts to an amplifier which boosts the voltage up to range from 14 to 7 volts dependent on the voltage inputted into the amplifier. This voltage in the range of 14 to 7 volts is then sent to the electrical solenoid valve controlling the lift ram 5, causing the valve to open and thereby allowing hydraulic oil to pass and fill the annular bore of cylinder thereby retracting the hydraulic ram 5 and moving the lift arm 25 downwardly.

[0032] As the lift arm 25 moves downwardly the absolute encoder 12 relays the information regarding the actual position of the lift arm 25 to the discrete input module which is in turn sent by the PLC. If this position information reaches a pre-determined parameter setting, the PLC will limit the voltage from the analogue output module and thereby prevent certain manual movement.

[0033] When the first joystick (joystick A) is moved forward of centre in manual mode, a voltage of between 5 and 0 volts is sent to the analogue input module of the PLC. The further forward of centre of the movement of joystick A, the lower the voltage becomes, down to a minimum of 0 volts. This voltage signal is read by the PLC and if all conditions relating to the resulting movement (i.e. the swing/tilt arm 26 swinging forward) are met, the analogue output module of the PLC will send a corresponding voltage signal also in the range 5 to 0 volts to an amplifier which boosts the voltage up to a range from 14 to 7 volts dependent on the voltage inputted into the amplifier. This voltage in the range of 14 to

7 volts is then sent to the electrical solenoid valve controlling the swing rotary actuator 6, causing the valve to open and thereby allowing oil to pass and fill the B part of the swing rotary actuator 6 and causing the swing/tilt arm 26 to move forwardly.

[0034] As the swing/tilt arm 26 moves forward, the value on absolute encoder 14 which is mounted on the axle of the swing/tilt arm 26 decrements and relays information regarding the actual position of the swing/tilt arm 26 to the discrete input module of the PLC which is in turn read by the PLC. If this position information reaches a pre-determined parameter setting, the PLC will limit the voltage from the analogue output module and thereby prevent certain manual movements.

[0035] When the first joystick (joystick A) is moved backwards of centre in manual made, a voltage of between 5 and 10 volts in sent to the analogue input module of the PLC. The further backwards of centre the joystick A is moved, the greater the voltage of the signal which is sent to the PLC, up to a maximum limit of 10 volts.

[0036] This voltage signal is read by the PLC and if all conditions relating to the resulting movement (i.e. swing/tilt arm 26 tilting up) are met, then the analogue output module will send a corresponding voltage signal also in the range 5 to 10 volts to an amplifier which boosts the voltage up to a range from 14 to 20.7 volts dependent on the voltage inputted into the amplifier. This voltage in the range of 14 to 20.7 volts is then sent to the electrical solenoid valve that controls the swing actuator 6, allowing oil to pass into the "A" part of the rotary actuator thereby moving the swing/tilt arm 26 backwards.

[0037] As the swing/tilt arm 26 moves backwards the absolute encoder 14 relays information regarding actual position of the swing/tilt arm 26 to the discrete input module of the PLC, which is in turn read by the PLC. If the position information reaches a pre-determined parameter setting, the program will limit the voltage from the analogue output module and thereby prevent certain manual movement.

[0038] When the second joystick (joystick B) is moved left of centre in manual mode, a voltage of between 5 and 10 volts is sent to the analogue input module of the PLC. The further left of centre the joystick is moved, the greater the voltage up to a maximum of 10 volts, of the signal which is sent to the PLC.

[0039] This voltage signal is read by the PLC and if all conditions relating to the resulting movement (i.e. Tilt up) are met, then the analogue output module will send a corresponding voltage signal also in the range 5 to 10 volts to an amplifier which boosts the voltage up to a range from 14 to 20.7 volts dependent on the voltage inputted into the amplifier.

[0040] This 14 to 20.7 volts is then sent to the electrical solenoid valve that controls the tilt ram 7, allowing hydraulic oil to pass and fill the full bore of the cylinder thereby extending the tilt ram 7, and moving the tilt arm 27 up.

[0041] As the swing/tilt arm 26 moves up, the absolute encoder 16 relays information to the discrete input module of the PLC regarding the actual tilting position of the swing/tilt arm 26.

[0042] This information is read by the PLC and if this position information reaches a pre-determined parameter setting, the PLC controlling the operational cycle will limit the voltage from the analogue output module thereby preventing certain movements in manual mode.

[0043] When the second joystick (joystick B) is moved right of centre in manual mode, a voltage of between 5 and 0 volts is sent to the analogue input module of the PLC. The further right of centre the joystick is moved, the lower the voltage becomes, down to a minimum of 0 volts. This voltage signal is read by the PLC and if all the conditions relating to the resulting movement (i.e. the swing/tilt arm 26 tilting downwardly) are met, then the analogue output module will send a corresponding voltage signal also in the range 5 to 0 volts to an amplifier which boosts the voltage up to a range from 7 to 14 volts dependent on the voltage inputted into the amplifier. This voltage of 7 to 14 volts is then sent to the electrical solenoid valve that controls the tilt ram 7 causing the valve to open and allowing hydraulic oil to pass and fill the annular bore of the cylinder of the tilt ram 7 thereby retracting the tilt ram 7 and causing the tilt arm 27 to tilt downwardly.

[0044] The information regarding the actual tilt position of the swing/tilt 26 arm is relayed by the encoder 16 to the discrete input module of the PLC. If this position information reaches a pre-determined parameter setting, the PLC will limit the voltage from the analogue output module and thereby prevent certain movements in manual mode. This safety mechanism provides the safety interlocks referred to above.

[0045] When the second joystick (joystick B) is moved forward of centre by at least one notch, a signal is sent to the discrete input module and if all conditions relating to the resulting movement (i.e. turning forward of the grab unit 30) are met, then a signal is sent from the discrete output module to a relay which in turn sends 24 volts to the electrical solenoid valve that controls the "A" port of the turn hydraulic ram 8 thereby causing the valve to open and allowing oil to pass and fill the full bore of the cylinder of the turn hydraulic ram 8 until a signal from the fully forward proximity sensor is sent to the discrete input module resulting in the signal from the discrete output module being terminated.

[0046] When the second joystick (joystick B) is moved backwards of centre by at least one notch, a signal is sent to the discrete input module and if all conditions meet, then a signal is sent from the discrete output module to a relay which in turn sends a 24 volt signal to the electrical solenoid valve that controls the "B" port of the turn hydraulic ram 8 thereby causing the valve to open and allowing oil to pass and fill the annular bore of the turn hydraulic ram 8 thereby retracting the Swivel ram 8.

Until the fully back proximity sensor sends a signal to the discrete input module resulting in the signal from the output module being terminated.

[0047] When the third joystick (joystick C) is moved up from centre by at least one notch, a signal is sent to the discrete input module and if all conditions relating to the resulting movement i.e. tipping up of the grab unit 30 are met, then the analogue output module will send a signal of between 5 and 10 volts, which will be determined by the PLC to an amplifier which boosts the voltage to a range between 14 to 20.7 volts dependent of the voltage inputted into the amplifier. This voltage of between 14 to 20.7 volts is sent to the electrical solenoid valve that controls the tip actuator 9 and allows hydraulic oil to pass and fill the "A" port of the tip rotary actuator 9 thereby moving the tipping head 29 up.

[0048] As the tipping head 29 moves upwardly, the absolute encoder 18 relays the information regarding the actual position of the tipping head 29 to the discrete input module, which is in turn read by the PLC. If this position information reaches a pre-determined parameter setting, the PLC will limit the voltage from the analogue output module and thereby prevent certain movements in manual mode. This provides another safety interlock feature.

[0049] When the third joystick (joystick C) is moved down from centre by at least one notch, a signal is sent to the discrete input module and if all conditions relating to the resulting movement (i.e. tipping down of the grab unit 30) are met, then the analogue output module will send a voltage of pre-determined value between 5 and 0 volts to an amplifier which boost the voltage to a range between 14 and 7 volts dependent on the voltage inputted into the amplifier. This signal of 14 to 7 volts is sent to the electrical solenoid valve that controls the tip actuator 9 thereby causing the valve to open and allowing the hydraulic oil to pass and fill through the "B" port the tip rotary actuator 9 thereby moving the tip head 29 down.

[0050] As the tip head 29 moves down, the absolute encoder 18 mounted on the axle of the Tip head 29 decrements and relays this information regarding the actual position of the tip head 29 to the discrete input module which is in turn read by the PLC. If this position information reaches a pre-determined setting, the PLC will limit the voltage from the analogue output module thereby preventing certain movements in manual mode.

[0051] Once the joysticks have been manipulated as described above and the garbage container has been successfully lifted from the ground to an initial position just above the ground, the automatic garbage container emptying cycle can commence. The operator can select automatic mode by pressing a button on the joystick console. By selecting automatic mode, manual control via the joystick is disabled except for the emergency stop mechanism which can be operated by manual control. Under automatic control, the PLC decides the direction and speed each actuator will move until the garbage container is positioned over the collecting container hopper. The speed and direction of each movement is dependent on the position of the lift arm 25, the swing/tilt arm 26 and the tipping head 29 at the on-set of automatic mode. When the garbage container is emptied, the PLC returns each arm and tipping head 29 to the start position at the same speed and ceases automatic movement, at the same time returning manual control to the operator. When the sequence is complete, the operator is informed by a light on the joystick console and once again manual operation is reinstated.

[0052] Apart from the automatic garbage container-emptying cycle, there is a second automatic cycle available to the operator in the home sequence to return the arm mechanism 4 to the "home" position. This cycle is performed without a garbage container being grasped by the arm. After selecting the home sequence by pressing another button on the joystick console, the PLC again decides the direction and speed of each actuator until the entire arm is folded away ready for transport. While this sequence is in operation, manual control is disabled. When the sequence is complete the operator is informed by a light on the joystick console and once again manual operation is reinstated.

[0053] Referring to Figure 15, the operation of the hydraulic circuit used in the garbage collection truck will now be described.

[0054] The primary function of the hydraulic circuit used in the garbage collection truck is to convert the truck's power to a controllable mechanical action, which in turn is used to control the actions of the lift arm.

[0055] To achieve the primary function of controllable mechanical action, the truck has been fitted with a load sensing hydraulic system. The load sensing system differs from conventional systems in that it will only deliver the flow of oil that is required. As shown in Figure 15, the system has a special feed back line from the main block to the load sensing pump. This feedback line informs the pump of the consumption of oil and hence how much oil the pump is to deliver. To further increase the controllability of the arm mechanism 4, the valves used to control the movements of the lift, swing, tilt and tip actions can deliver a flow of oil that is proportional to the amount by which the joystick is moved off centre. This gives the operator full control over the speed of the lift arm 25, and swing/tilt arm 26 and grab unit 30 and hence the positional accuracy. The programmable logic controller (PLC) also takes advantage of the proportional operation of the lift, swing, tilt and tip valves as the range of speeds permits the use of uniform acceleration and deceleration thereby increasing the respective arms 1 fluidity of movement during homing and automatic cycles.

[0056] The turn and clamp cylinders are non proportional, as these actions only require one slow speed i.e. the valves used to control the turn and clamp actions do not deliver a flow of oil that is proportional to the amount by which the joystick is moved off centre.

[0057] The hydraulic circuit comprises the following elements:

Suction filters 101,102 for the two hydraulic pumps. The suction filters 101,102 ensure that any foreign objects which may have entered the system from the hydraulic tank, are screened out before entering the hydraulic pumps;

Load sensing pump 104 which is used to deliver the hydraulic power requirement of the extension arm mechanism 4.

Pressure filter 106 is used to protect the main hydraulic valve block from foreign objects;

Systems main pressure relief valve 107; in the event of the system building up pressure which is greater than that permissible for the system, the pressure relief valve 107 will relieve the pressure by allowing the oil to flow back to the hydraulic tank.

[0058] Valve 108 which is a solenoid operated, four port, two position valve. The pressure and tank lines join in the neutral position, this means that the valve 108 operates as a master valve, controlling the supply of oil to the main block.

[0059] Valves numbered 109,110,111 and 112 are all solenoid operated, proportional valves. The fact that these valves 109,110,111 and 112 are proportional permits the valves to control the flow rate of oil anywhere between maximum and zero to each actuator.

[0060] Valve numbered 113 and 114 are non proportional valves, that is to say that these valves do not possess the capability to vary the flow rate into the cylinders. Therefore, valves 113,114 can only operate at one flow rate, hence given the actuators which they control, namely, the turn hydraulic ram 8 and clamp ram 10, there is only one fixed operating speed possible for these rams 8,10.

[0061] Components numbered 115,116,117,118,119 and 120 are all internal cross line relief valves. These valves 115,116,117,118 and 119 can be set to limit the working force of each actuator. In the case of the present invention these valves 115,116,117,118 and 119 have been set to limit the lifting force to that required to lift 250Kg and also to limit the down force to the minimum required to place the garbage container back on the pavement, as a result the forces applied in an accidental collision can be limited.

[0062] Valves numbered 121,122,123,124 and 125 are all dual over-centre valves. These valves 121,122,123,124 and 125 require a signal pressure from the pressure line before they will open for operation. The valves 121,122,123,124 and 125 are used to prevent the arm drifting in the transport position. They are also used to prevent the arm from falling from an elevated portion, in the event of a major oil leak. The valves 121,122,123,124 and 125 prevent the rate of movement of any particular component from being faster than the rate of flow of oil to the pump, thereby increasing the fluidity of movement of the arm.

[0063] Valve number 126 is a pilot operated check valve. This valve 126 compares the pressure trying to open the cylinder with a pre-applied spring pressure. The valve is used in the device of the present invention to prevent the lifted garbage container from opening the clamp during a tipping operation.

[0064] The hydraulic line 133 in Figure 15 is the load sensing line, this line provides feed back to the load sensing pump to inform the pump of the consumption of oil, the pump then responds by delivering more or less oil depending on the signal given.

[0065] The interchangeable collection container 90 provided on the truck 1 as shown in Figure 16 may be of the type described in European Patent Specification No. EP 0 638 491 and includes a receiving member (not shown) coupled to a compacting member (not shown) for compacting garbage deposited in the receiving member into the container. Alternatively, the collection container may be of another type, for example, an open top container.

[0066] The advantage of the truck and device of the present invention is that the device is easily manoeuvred to a high degree of accuracy so that the device can reach for garbage containers which have been collected together in a group and are arranged in a random fashion, without having to move the truck. The device can be manipulated so that successive garbage containers at a collection point can be grabbed, lifted, tipped and returned to the ground, the movements of the arm are not jerky but are smooth during both manual and automatic operation.

[0067] It will of course be understood that the invention is not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the invention as defined in the appended claims.

Claims

1. A device (4) for taking up a garbage container and emptying it into a collection container positioned on the chassis (1) of a garbage collection truck, said device (4) comprising a gripping member (30) being operable to grip the garbage container, raise it and tilt it over, so that the garbage present therein falls out into the collection container (4), characterized in that the device comprises a lift arm (25) and a swing/tilt arm (26) at the end of which is rotatably mounted the container engaging unit, the lift arm (25) being linked in a first parallel linkage arrangement (32) with a first pivot arm (33) and the swing/tilt arm being linked in a second parallel linkage arrangement with a second pivot arm (43); a

rotary actuator being provided between the first parallel linkage arrangement and the second parallel linkage arrangement so that the swing/tilt arm (26) can turn through an angle of approximately 90° about its axis of rotation in the horizontal plane, and also tilt upwardly and downwardly relative to the same axis, whereby a garbage container placed within the reach of the device and at the side of the truck can be gripped, picked up and be rotated rearwardly in order to be brought over the collection container and to be emptied thereinto and whereby the device is selectively operable to lift and empty individual garbage containers from a group of garbage containers without having to move the truck.

2. A device according to Claim 1, further characterized in that the device (4) for taking up a garbage container and emptying it into the collecting container includes the following actuators:

a lift hydraulic ram (5) for lifting the lift arm (25) up and lowering it down again;

a swing (rotary) actuator (6) connected to the swing/tilt arm (26) enabling the swing/tilt arm (26) to turn about the vertical axis perpendicular to the body of the truck;

a tilt hydraulic ram (7) mounted on the swing/tilt arm (26) for controlling the tilting of the swing/tilt arm (26);

a turn hydraulic ram (8) mounted on a turn head (28); for controlling the turn motion of the grab unit 30;

a tip (rotary) actuator (9) mounted on the tipping head (29) for enabling the grab unit (30) to grip the garbage container and, after the container has been raised by the device, for enabling the grab unit (30) to tilt the garbage container over so that the garbage present therein falls out into the collection container;

a clamping hydraulic ram (10) for controlling the clamping and unclamping of the garbage container by the grab unit 30.

3. A device according to claim 2 characterized in that grab unit (30) is also operable to grip a garbage container which is standing on a surface which is not completely horizontal.

4. A device according to any one of the preceding claims, characterized in that the device (4) for taking up a garbage container is controllable in both manual and automatic modes; control in manual mode being exercised by means of an operator manipulating joysticks in the cab of the truck and control in automatic mode being carried out by a programmable logic controller (PLC), whereby during an operational cycle through which the device (4) moves to grab the garbage container, lift it from the ground and position it over the collecting container, tilt the garbage container to an appropriate angle to empty the contents of the garbage container into the collecting container, lower the garbage container and position it back on the ground, the device (4) is controlled in manual mode for certain stages of the operational cycle and in automatic mode for other stages of the operational cycle.

5. A device according to claim 4, characterized in that the operational cycle includes a start-up sequence during which the device (4) is moved from a folded transportation position at the rear of the truck cab to a position in which it is extended in the direction of the garbage container and also includes a "homing" sequence during which the device returns from the extended position to the folded transportation position.

6. A device according to any one of claims 2 to 5, characterized in that in automatic mode information regarding the position of each of the arms is relayed back to the PLC by optical encoders.

7. A garbage collection truck including a device as claimed in any one of the preceding claims and a demountable garbage container.

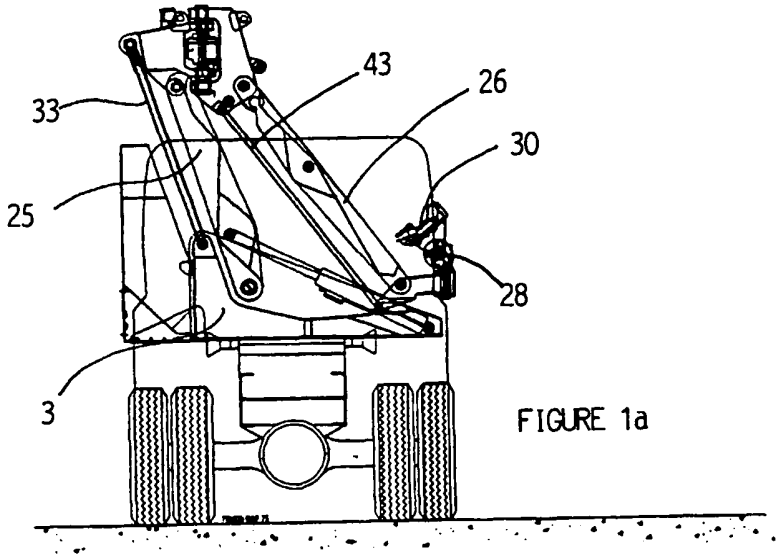


FIGURE 1a

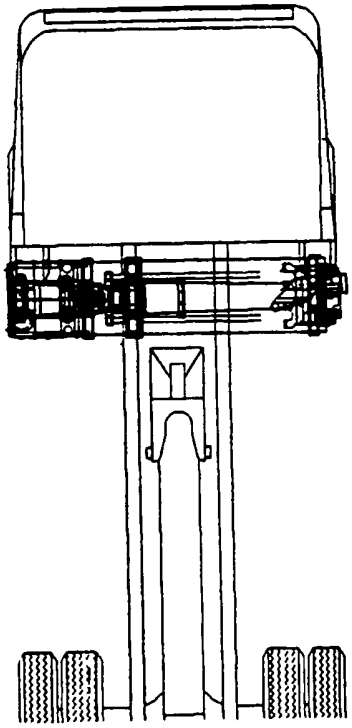


FIGURE 1b

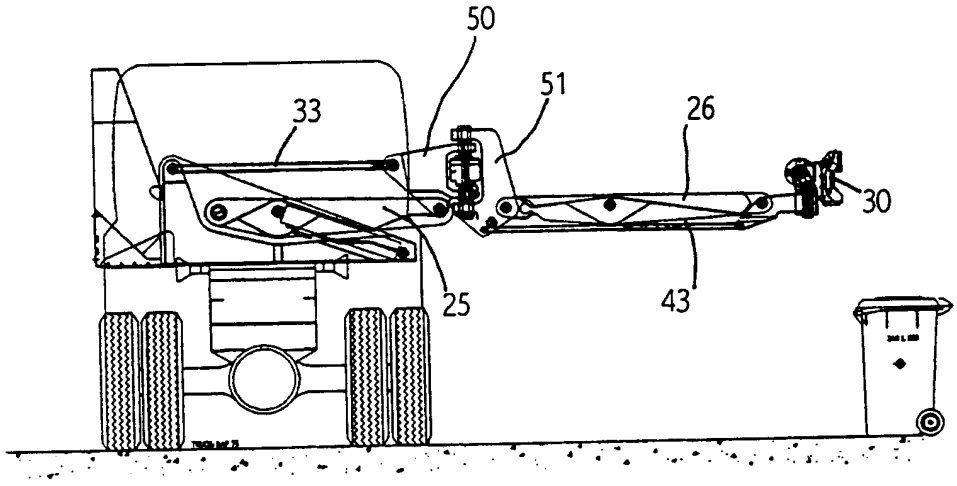


FIGURE 2a

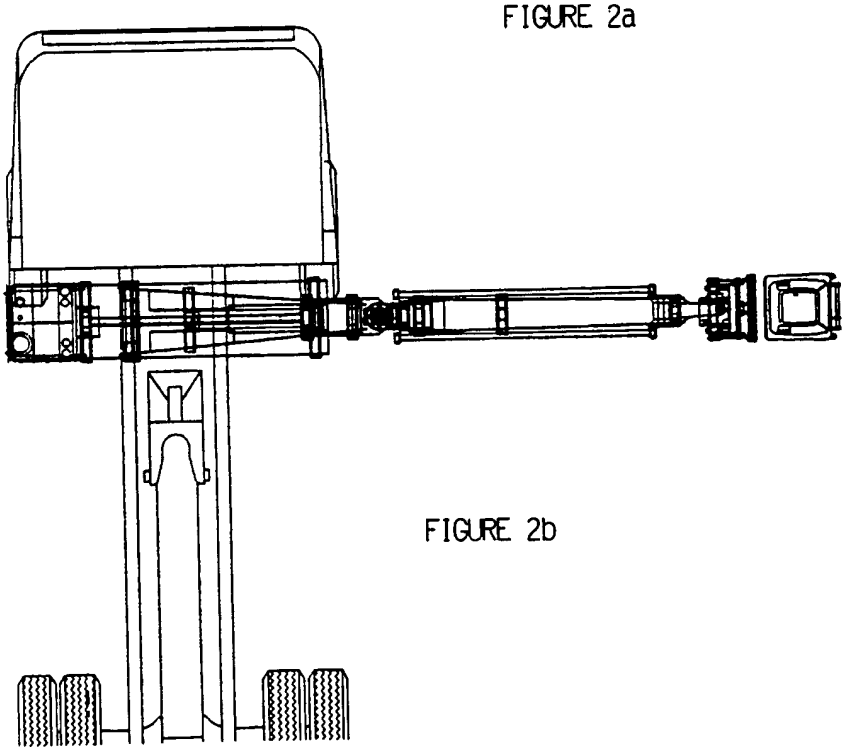
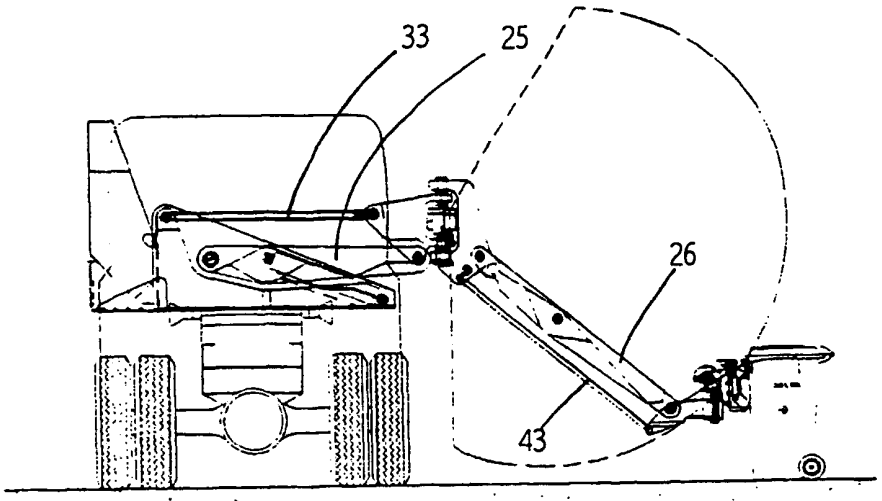


FIGURE 2b

FIGURE 3a



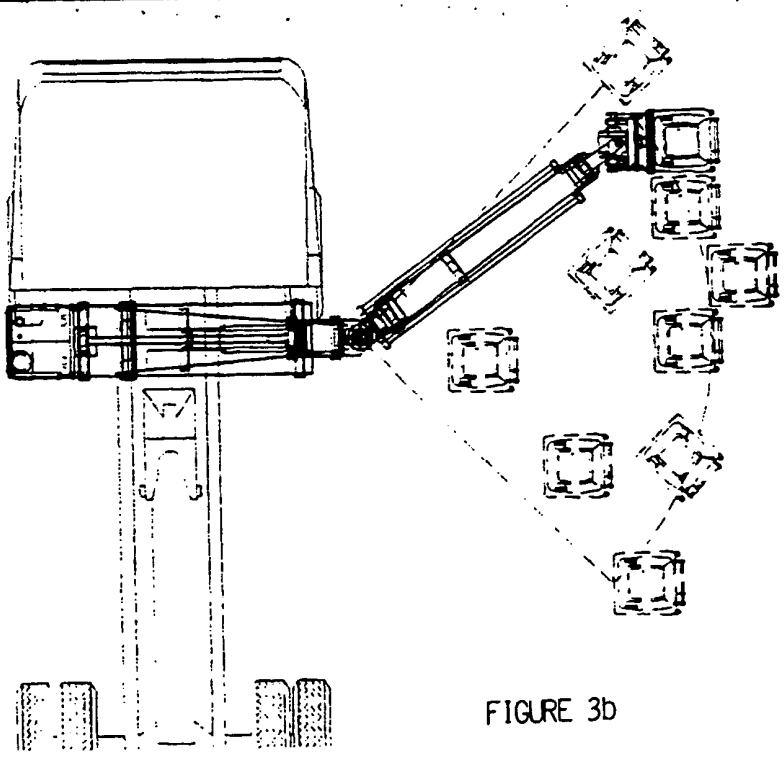


FIGURE 3b

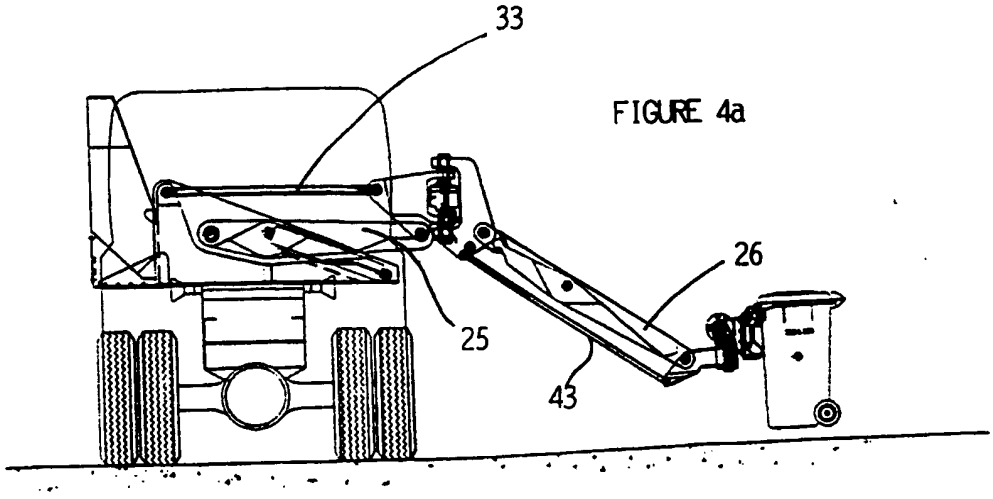


FIGURE 4a

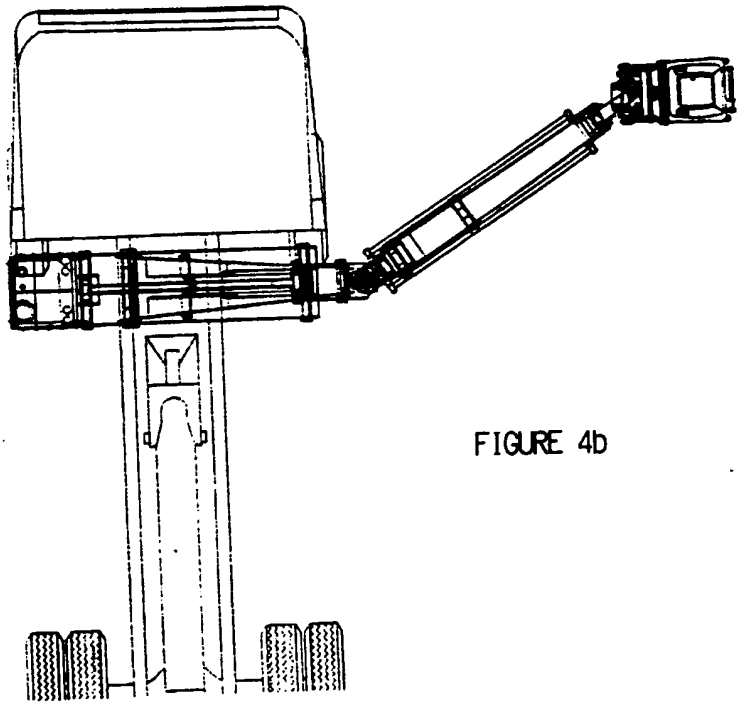


FIGURE 4b

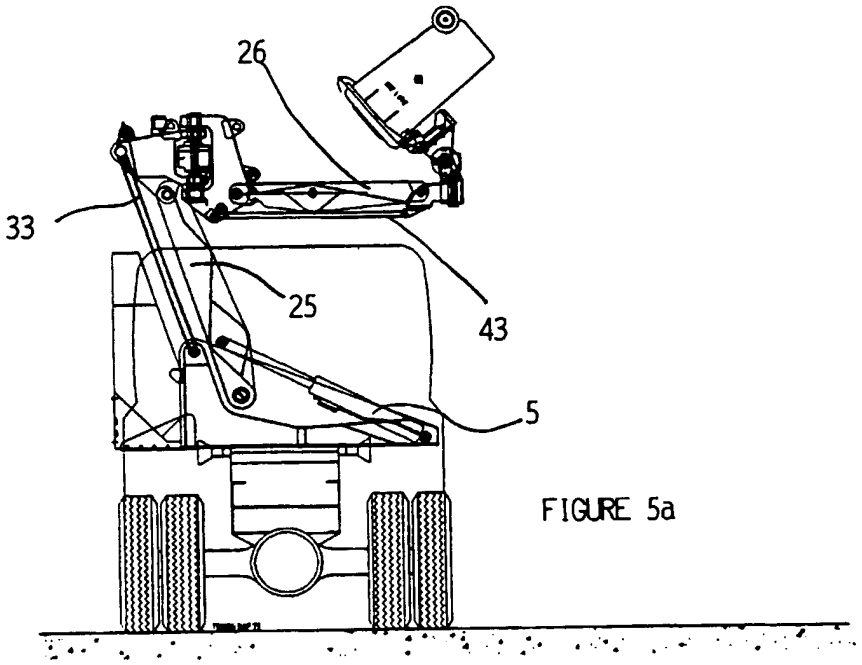


FIGURE 5a

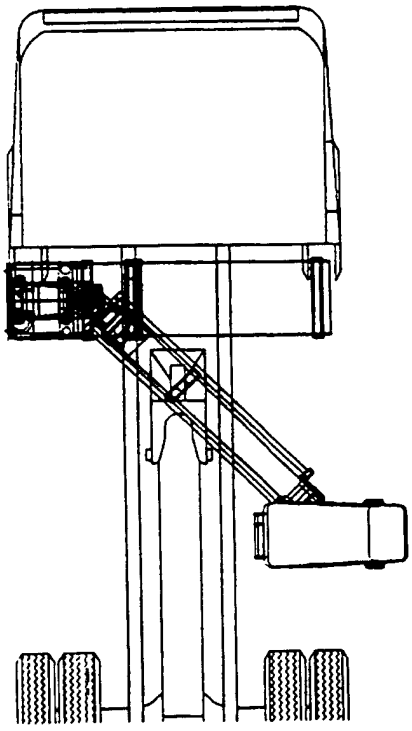


FIGURE 5b

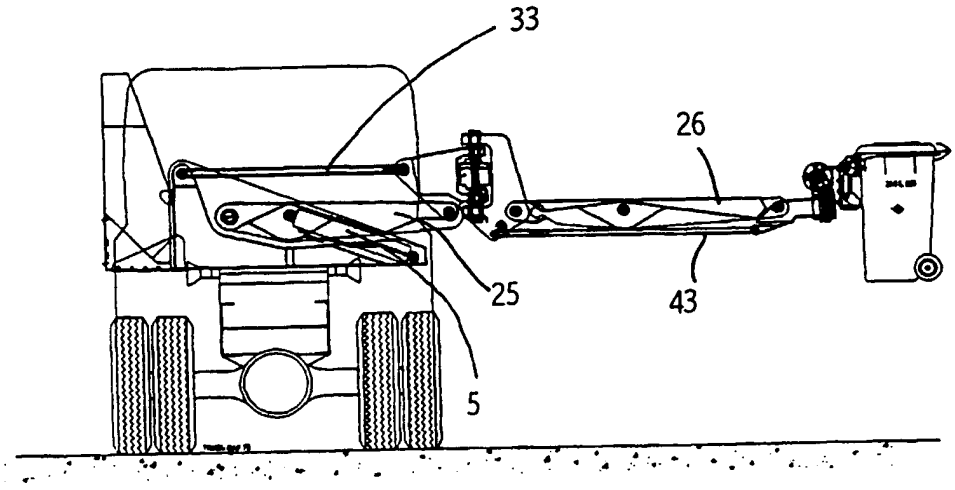


FIGURE 6a

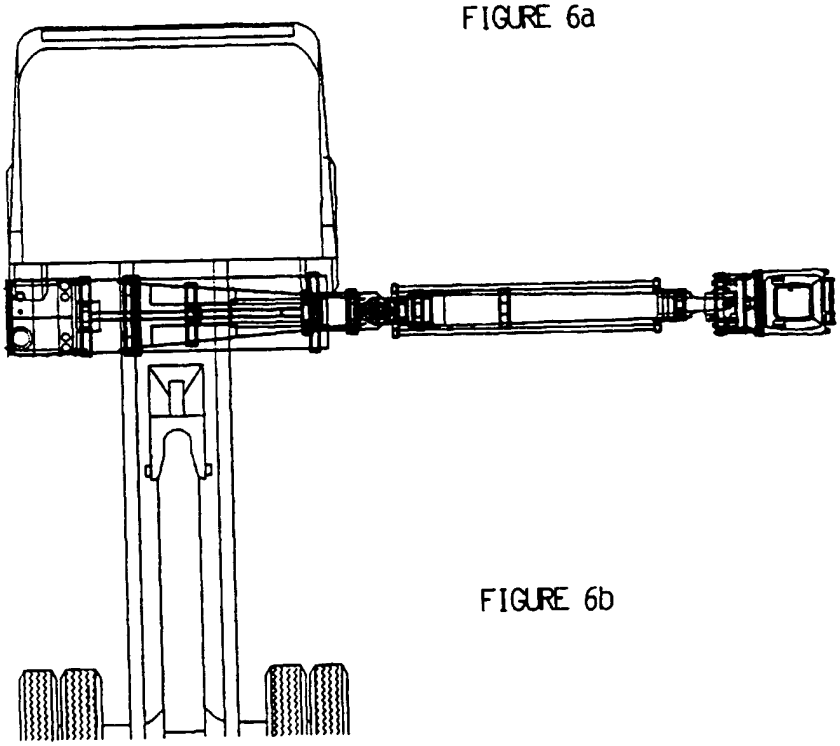


FIGURE 6b

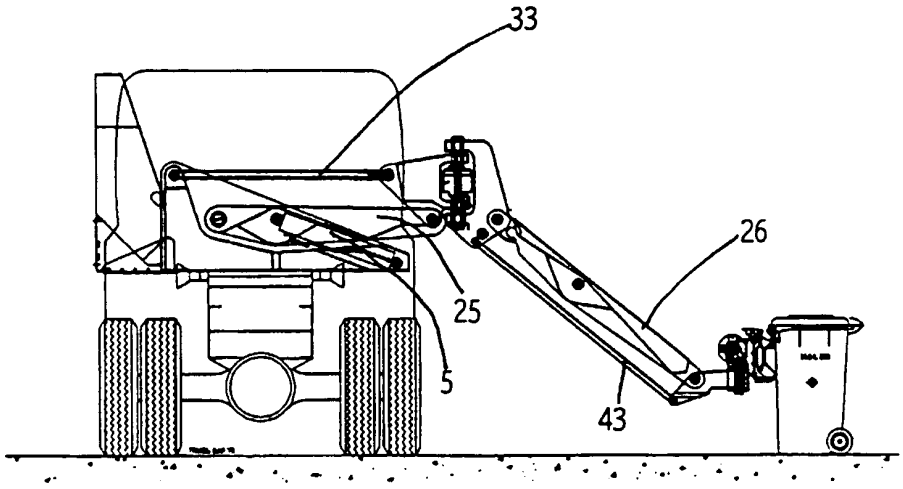


FIGURE 7a

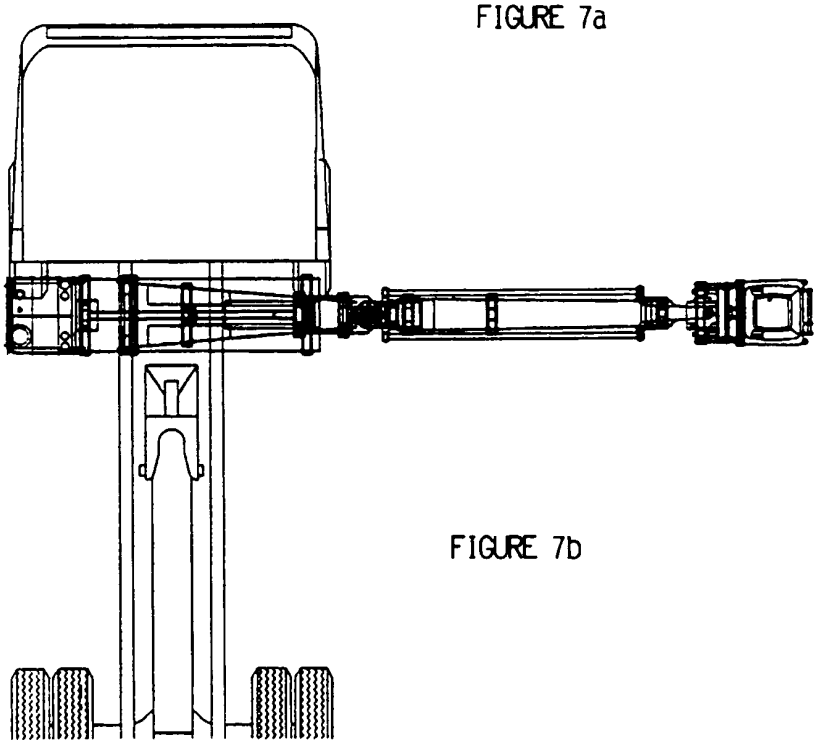


FIGURE 7b

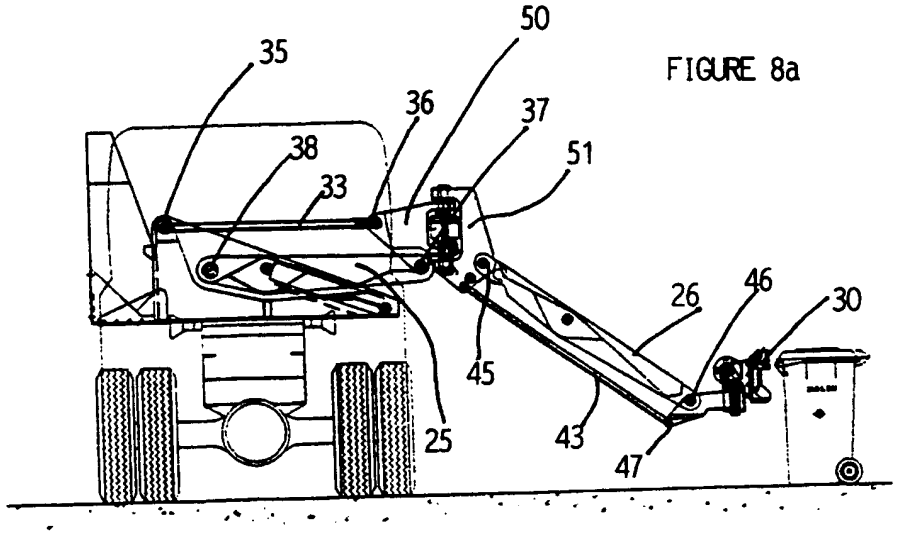


FIGURE 8a

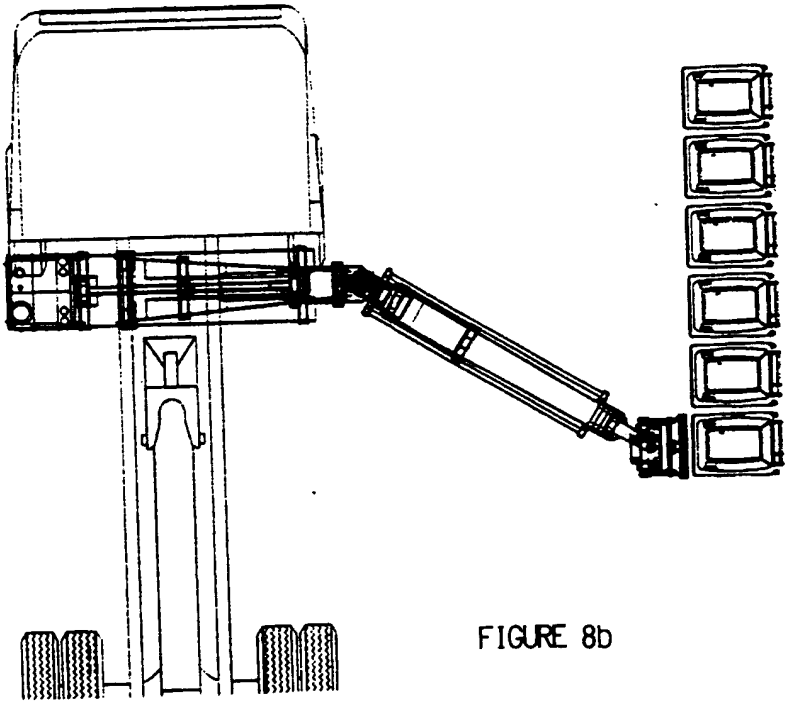


FIGURE 8b

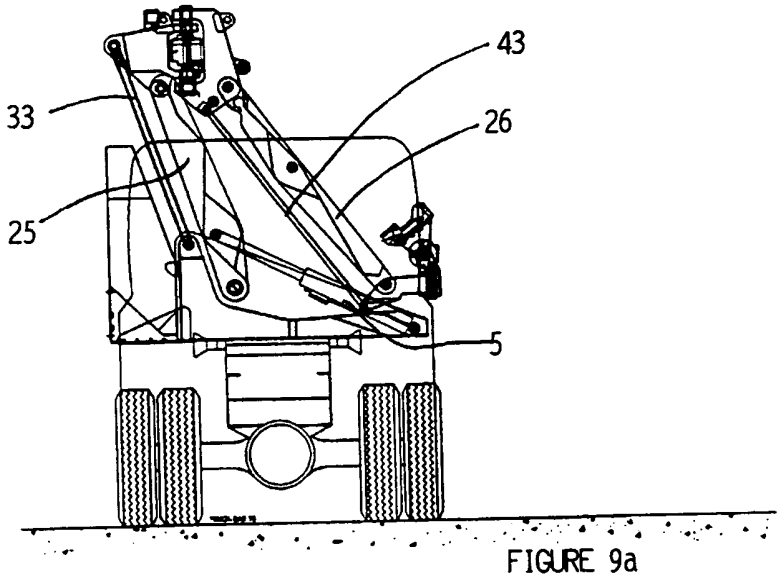


FIGURE 9a

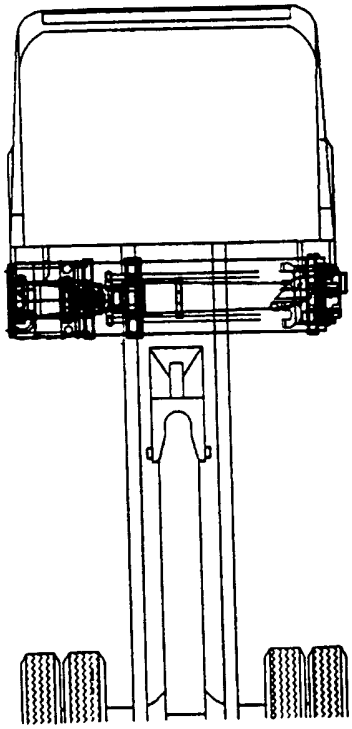


FIGURE 9b

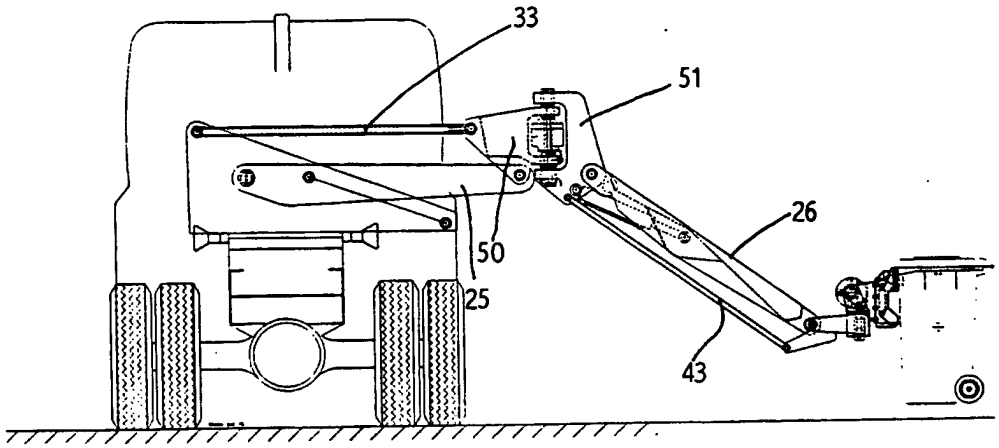


FIGURE 10a

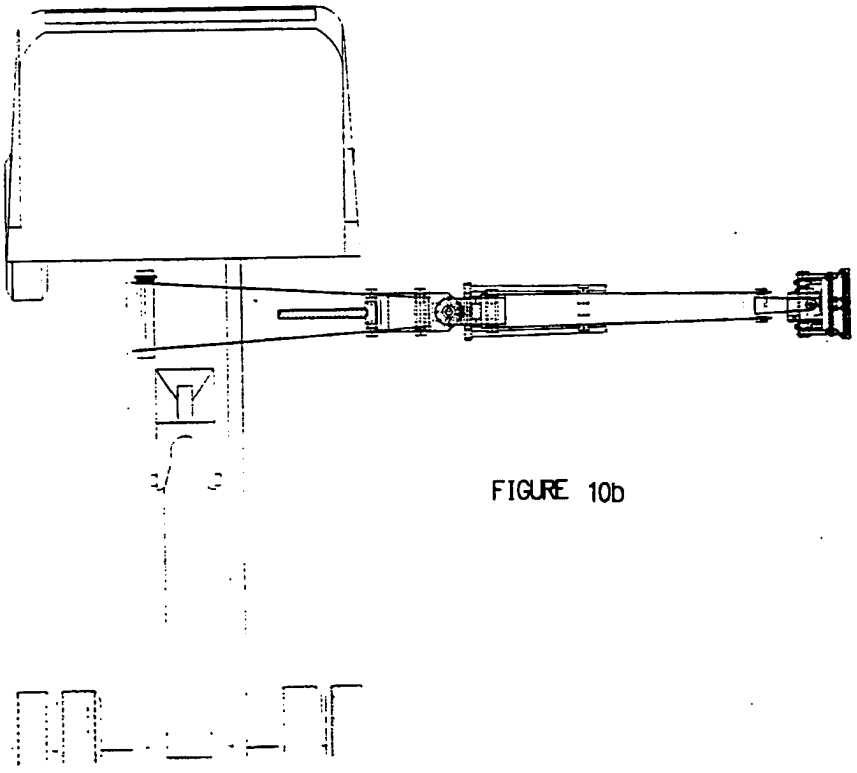


FIGURE 10b

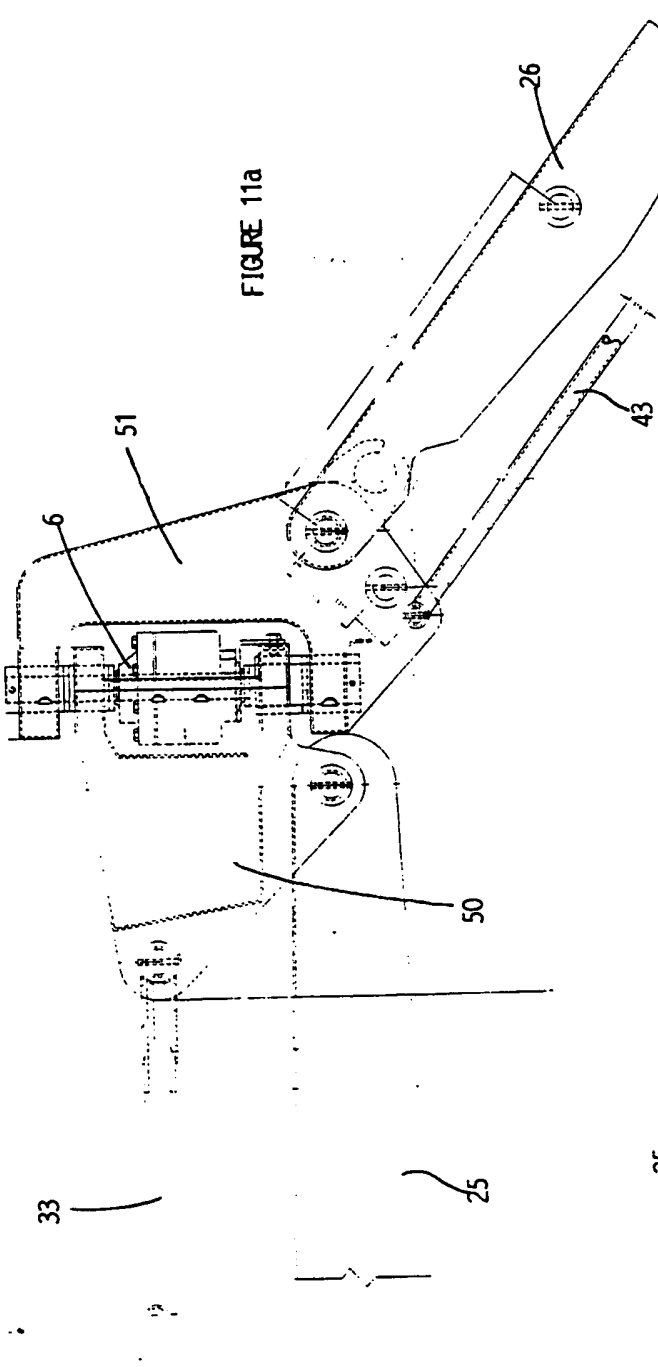


FIGURE 11a

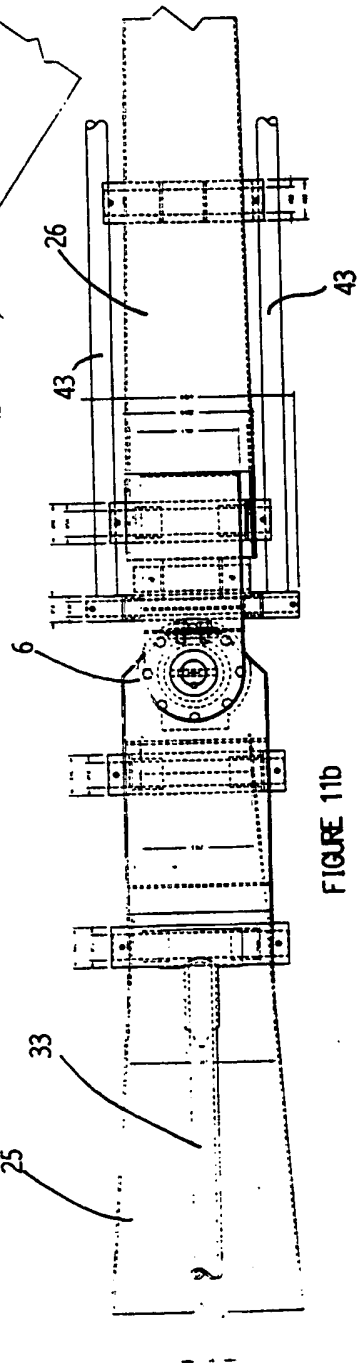


FIGURE 11b

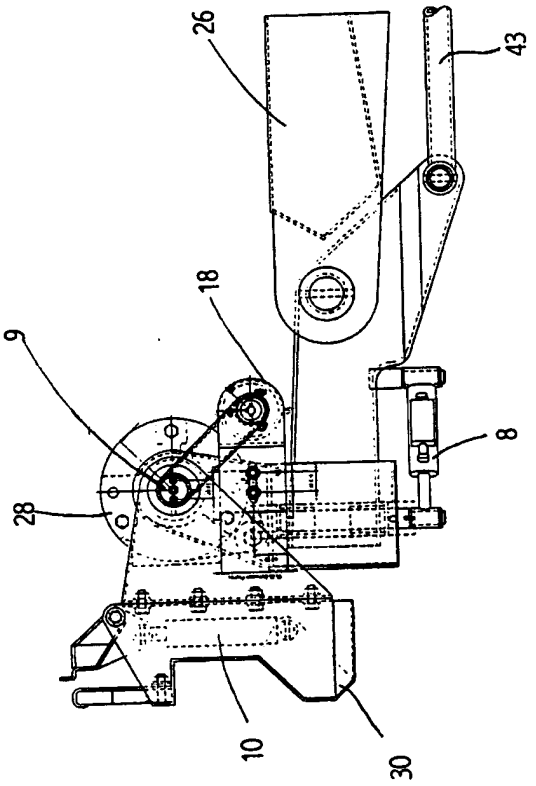


FIGURE 12a

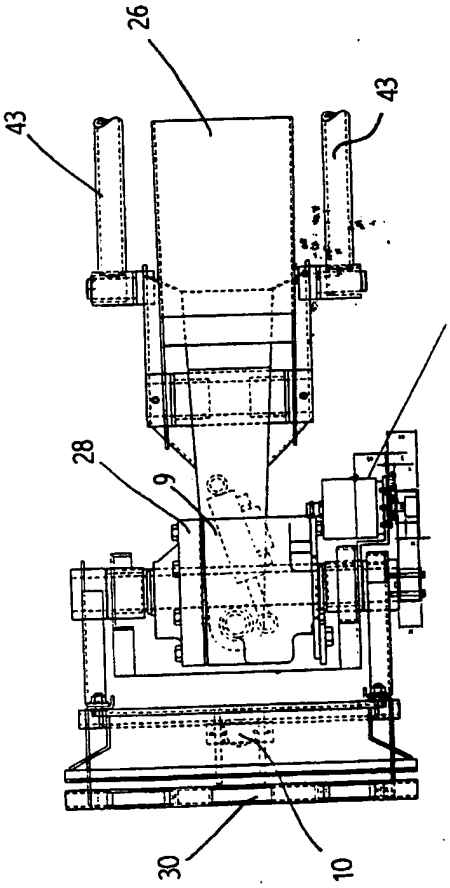


FIGURE 12b

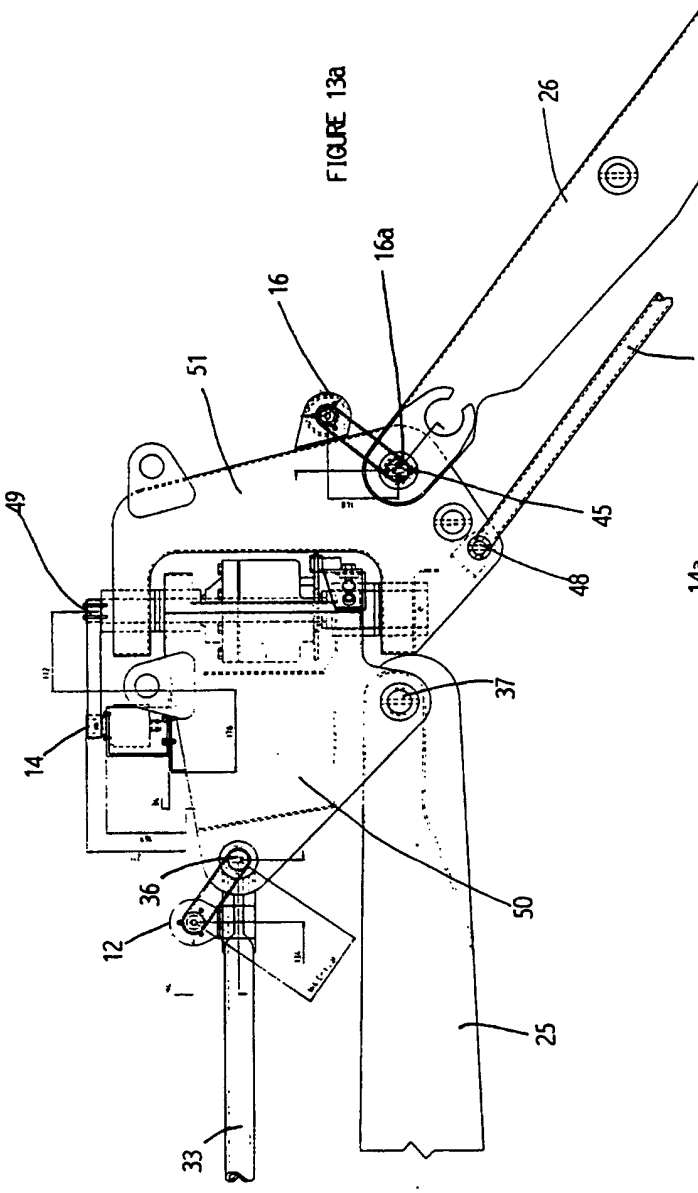


FIGURE 13a

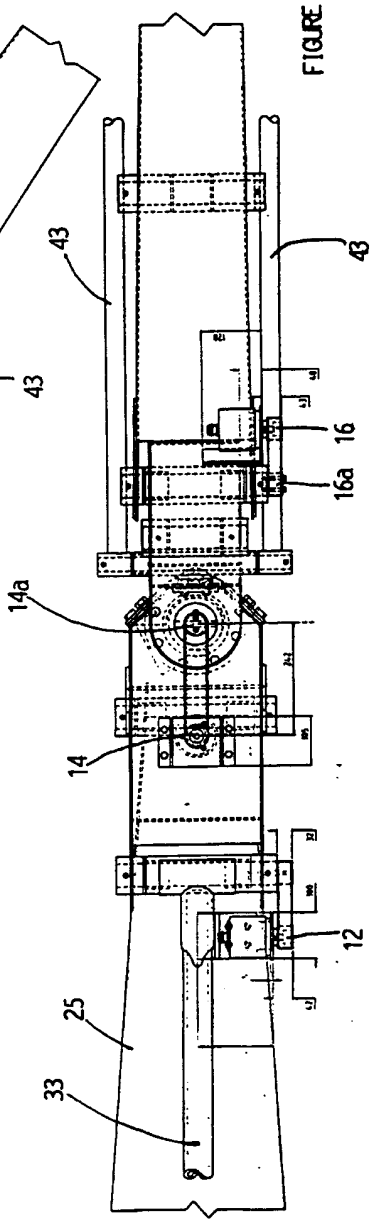


FIGURE 13b

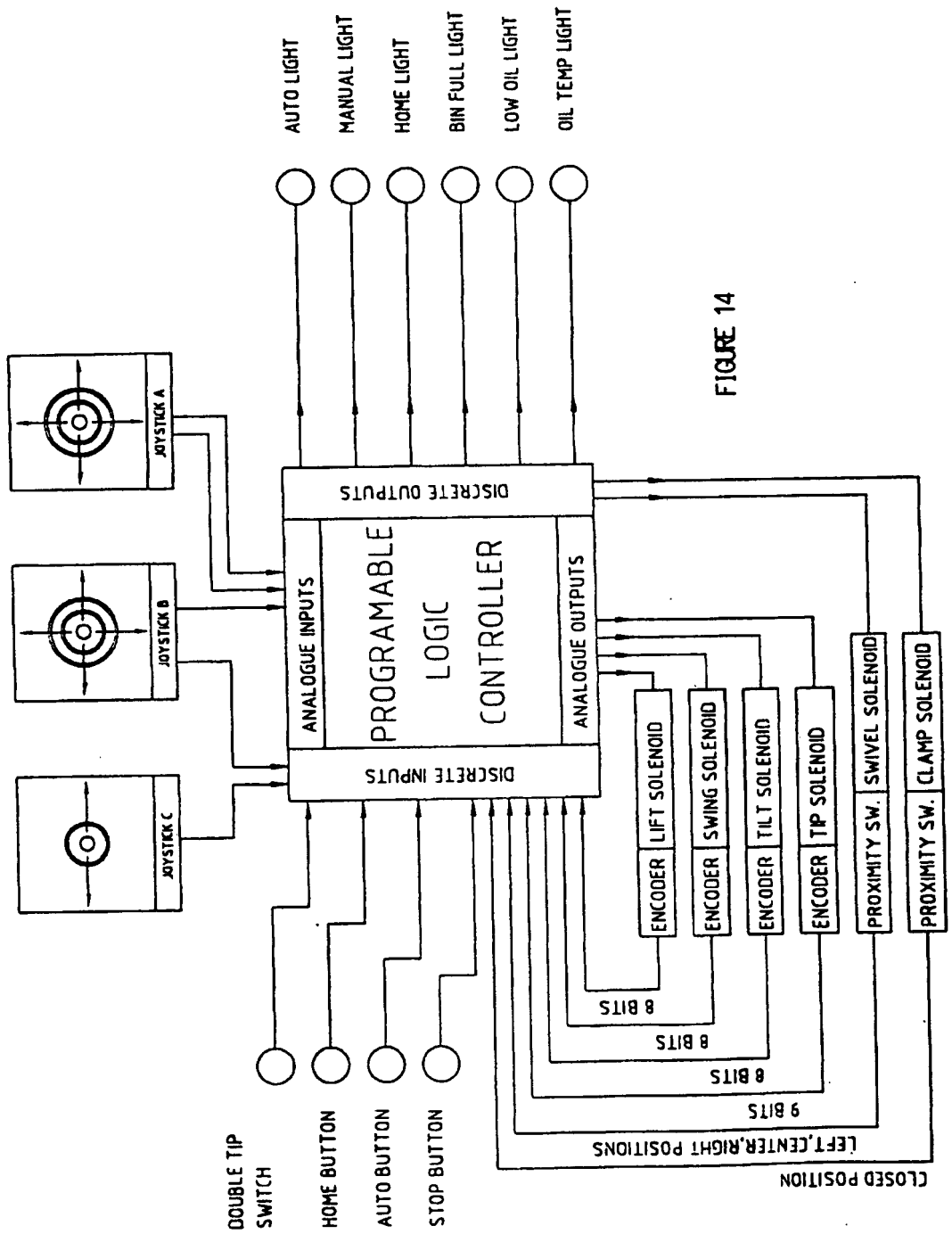
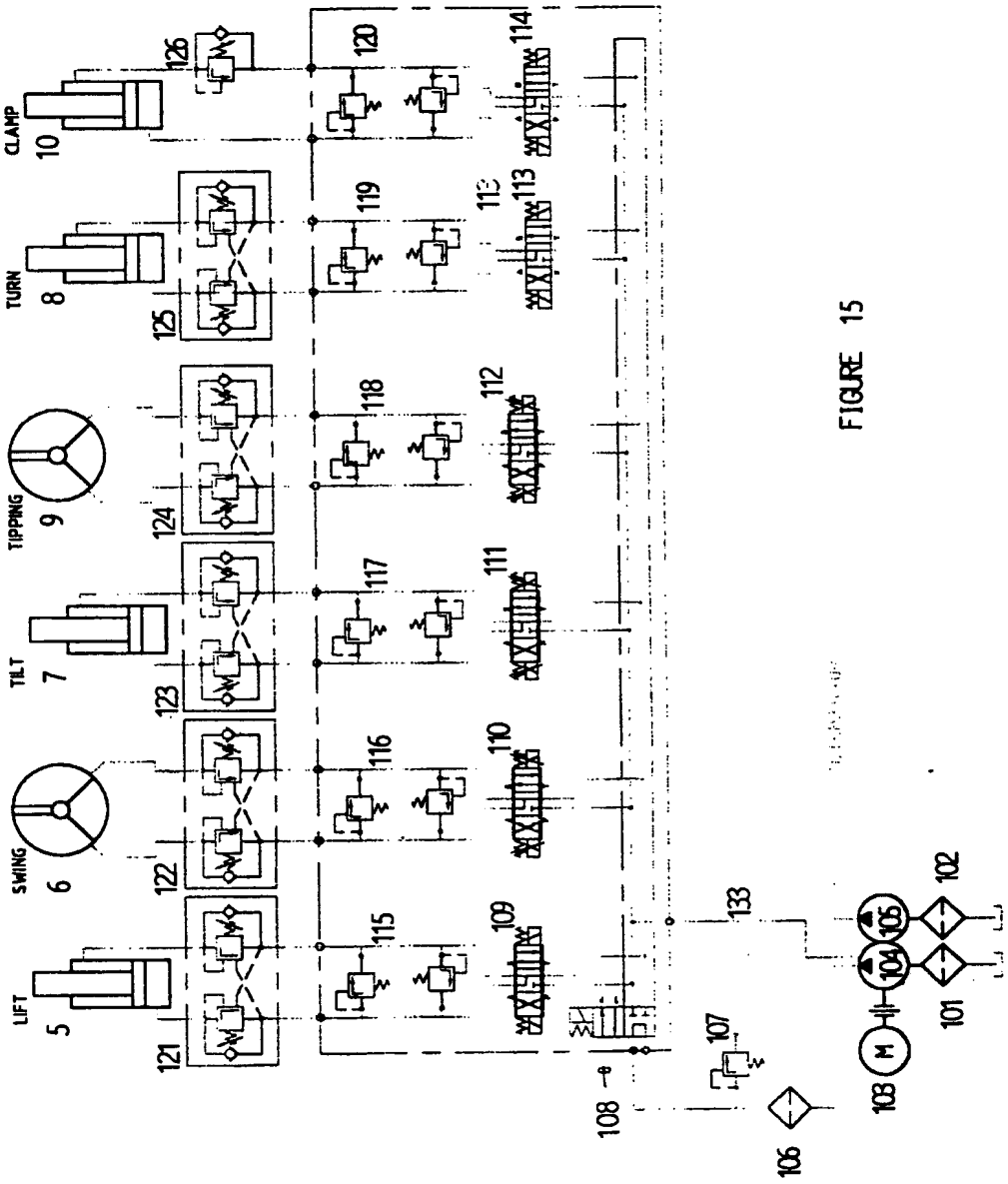

AUTO LIGHT
MANUAL LIGHT
HOME LIGHT
BIN FULL LIGHT
LOW OIL LIGHT
OIL TEMP LIGHT
JOYSTICK A
JOYSTICK B
JOYSTICK C
DISCRETE OUTPUTS
ANALOGUE INPUTS
PROGRAMABLE
LOGIC
CONTROLLER
ANALOGUE OUTPUTS
DISCRETE INPUTS
ENCODER
LIFT SOLENOID
ENCODER
SWING SOLENOID
ENCODER
TILT SOLENOID
ENCODER
TIP SOLENOID
PROXIMITY SW.
SWIVEL SOLENOID
PROXIMITY SW.
CLAMP SOLENOID
8 BITS
8 BITS
8 BITS
9 BITS
LEFT,CENTER,RIGHT POSITIONS
CLOSED POSITION
DOUBLE TIP SWITCH
HOME BUTTON
AUTO BUTTON
STOP BUTTON

FIGURE 14


LIFT
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TIPPING
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TURN
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FIGURE 15

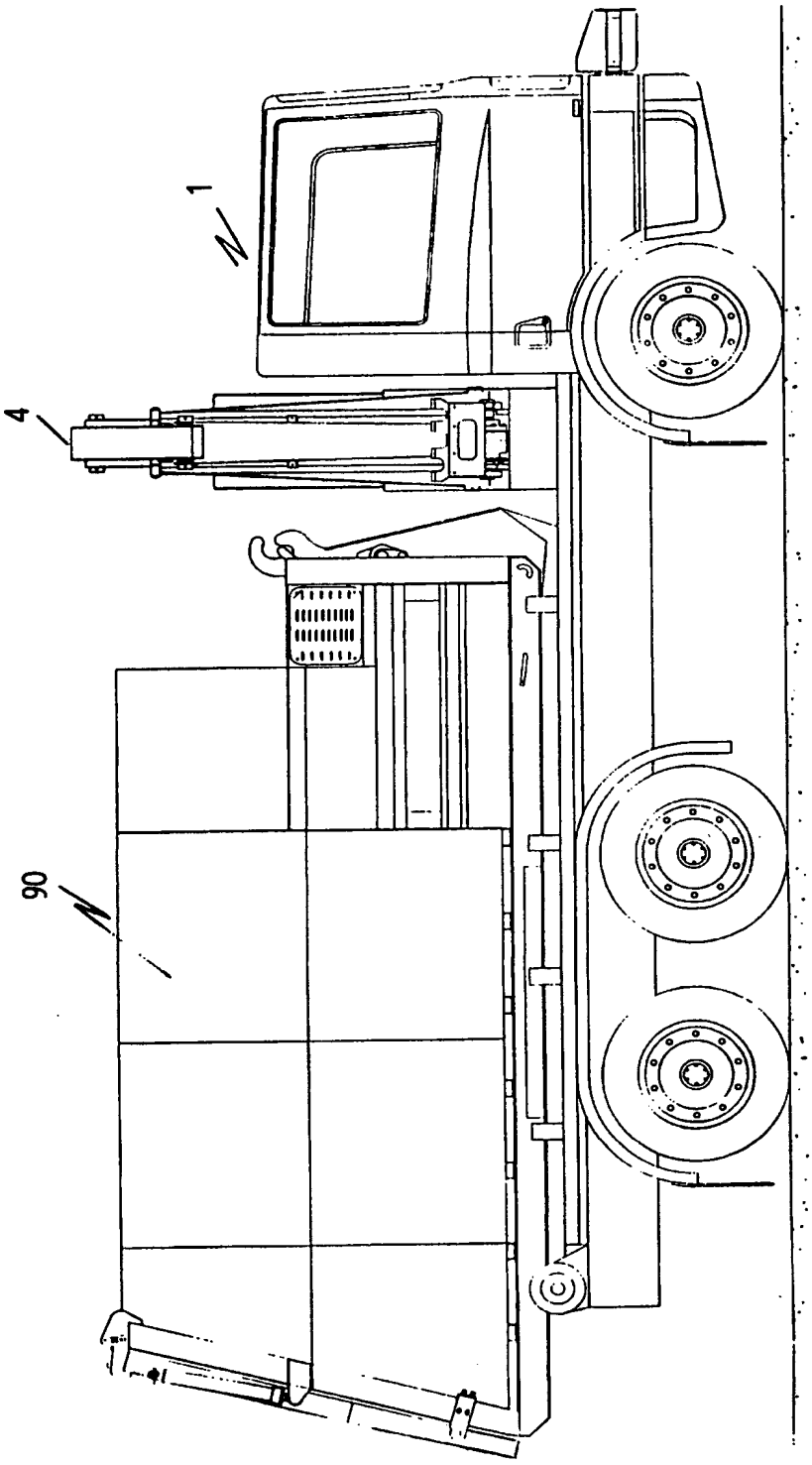

FIGURE 16

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 65 0030

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	EP 0 638 491 A (VAN DOOREMAAL HOLDING) * column 4, line 42 - column 6, line 17 * * figures 1-3 *	1,2,4,7	B65F3/04
A	AU 640 156 B (MACDONALD JOHNSTON ENGINEERING COMPANY PTY LTD) * page 3, line 15 - page 4, line 9 * * page 5, line 6 - line 22 * * figures 1-5 *	1,2,4	
A	WO 94 21541 A (THE HEIL COMPANY) * page 14, line 13 - page 17, line 35 * * figures 1-7 *	1,2,4	
A	WO 92 01612 A (S. HOLTOM) * page 7, line 10 - page 13, line 8 * * page 16, line 7 - page 22, line 6 * * figures 1-5,11 *	1,2,4	
A	US 5 018 929 A (W. CARSON) * column 7, line 61 - column 8, line 63 * * figure 7 *	1,4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B65F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 November 1997	Smolders, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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